Fiscal Year 2021 Competition Information Sheet - Process-Oriented Diagnostics for NOAA Climate Model Improvement and Applications

Program Name

Modeling, Analysis, Predictions, and Projections (MAPP) Program.

Program Mission

The mission of the Modeling, Analysis, Predictions, and Projections (MAPP) Program is to enhance the Nation's capability to predict variability and change in Earth's climate system. The MAPP Program focuses on the coupling, integration, and application of Earth System models and analyses across NOAA, among partner agencies, and with the external research community. Primary objectives include: 1) improving Earth System models; 2) supporting an integrated Earth System analysis capability; 3) improving methodologies for global to regional scale climate analysis, predictions, and projections; and 4) developing climate modeling capabilities and applications relevant to decision makers based on climate analyses, predictions, and projections. MAPP sits within the Earth System Science and Modeling Division (ESSM) of the NOAA Office of Oceanic and Atmospheric Research (OAR) Climate Program Office (CPO).

Focus for FY 2021

Process-Oriented Diagnostics for Climate Model Improvement and Applications

Funding for FY2021

Pending the availability of funds in FY 2021, the MAPP program anticipates a funding allocation of up to $2,000,000 for this competition.

Proposals may be for up to three years, up to $180,000/year for each Type I project and up to $750,000/year for the Type II project (only one Type II project may be funded; see below for definition of project types and differentiation between external and internal Type II proposal funding). A total of 7-9 projects may be funded.

Competition Information

In FY 2021, the MAPP Program is soliciting proposals to advance model diagnostic activities.

Climate and Earth System Model (ESM) development is a key component of NOAA's mission.[1,2] NOAA's models provide a vast resource of information to NOAA managers, decisionmakers, and scientists as well as external stakeholders interested in environmental change on various timescales. These models also serve as an incubator for and source of technology to advance operational prediction efforts across all timescales. Climate projections produced with NOAA's models undergird efforts to assess climate change and its impacts, and serve as direct inputs to the National Climate Assessment.[3,4] These models also serve as a laboratory to codify and test improved understanding of how the climate and Earth systems work, and engage NOAA scientists and the broader research community with each other to advance our understanding and ability to simulate the integrated climate and Earth systems.

To improve models, we need to better understand and benchmark process-level deficiencies that result in model performance biases for simulated Earth system and climate phenomena. Some of these biases are evidenced in long-running climate and ESM simulations while some biases can arise at the weather timescale, within a few days of model initialization. We need to better understand and describe the source of biases such as issues in models' physical process representation, model component interaction, and/or numerical approach. To this end, since FY 2015, the MAPP Program has been supporting community-based approaches to improve NOAA models via the development of process-level metrics and an open-source framework, an effort spearheaded by the MAPP Model Diagnostic Task Force (MDTF)[5].

In FY 2021, the MAPP program is soliciting proposals that address key issues in the representation of Earth system processes in CMIP6-era and developmental models to improve model fidelity. Proposals should focus on clearly-identified gaps in the existing MDTF software package[6,7,8], for example in (but not limited to) areas of open- and coastal ocean systems, atmospheric chemistry, and land surface and ecosystem processes. In addition, we encourage investigators to consider whether their proposed work can connect climate process model diagnostic efforts and potential downstream model improvements with model applications relevant to high-priority climate risk areas the Climate Program Office is organizing some of its activities around[9]: near-coastal marine conditions, extreme heat, water resources, and coastal inundation.

Projects selected via this solicitation are expected to go beyond diagnostic evaluations of model performance, to evaluate processes relevant to one or more of the above areas using CMIP6 or other relevant state-of-the-art datasets. Proposed work should develop and apply process-oriented diagnostics

[1] NOAA Next Generation Strategic Plan:
https://www.performance.noaa.gov/wp-content/uploads/NOAA_NGSP.pdf
[2] NOAA Office of Oceanic and Atmospheric Research Strategic Plan:
https://research.noaa.gov/Portals/0/Files/OAR%20Strategy%202020-2026.pdf
[3] Fourth National Climate Assessment, Volume I: https://science2017.globalchange.gov/
[4] Fourth National Climate Assessment, Volume II: https://nca2018.globalchange.gov/
[5]
https://cpo.noaa.gov/Meet-the-Divisions/Earth-System-Science-and-Modeling/MAPP/MAPP-Task-Forces/Model-Diagnostics-Task-Force
[6] https://www.gfdl.noaa.gov/MDTF-diagnostics/
[7] https://mdtf-diagnostics.readthedocs.io/en/latest/
[8] https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-18-0042.1
[9]
https://cpo.noaa.gov/News/ArtMID/7875/ArticleID/1945/NOAA's-Climate-Program-Office-launches-Climate-Risk-Areas-Initiative

(PODs) to enhance a process-oriented framework approach to discriminate and better understand the sources of bias in the models. Projects should develop a clear set of pathways for model improvement, and should examine the ways in which resolution, model formulation, and model components relate to the ability of the models to faithfully simulate the Earth system and its variability on various timescales. PODs may focus on processes covering a variety of timescales, including seasonal.

Model PODs and improvement pathways should be physically- and observationally-based, and be applicable across a variety of models to ensure robustness. Proposals are expected to have a very strong grounding in observational data, and should leverage publicly-available observational process data and observational resources such as Obs4MIPs, as well as new observational datasets that have been under-utilized for POD development and model evaluation. Utilization of NOAA in-situ and remote observations, as well as collaboration with NOAA observational entities, for example, within NESDIS, are strongly encouraged. Targeted experiments that extend proposed evaluations for the improvement of models, particularly NOAA climate and Earth System Models, may also be proposed. Proposed projects should have the overall aim to advance understanding of biases generally affecting CMIP6-era and next-generation models and to identify targeted model improvements that can improve model fidelity. The expected outcome of funded projects is a clear understanding of the sources of model biases and viable pathways for improving the models.

To address the above research areas, projects should use CMIP6 data, which has become increasingly available over the past couple of years, with a particular focus on MIPs that use the structure and organization provided by the CMIP umbrella. If using data from a particular MIP experiment, the proposal should demonstrate that the available data meets broadly-accepted resolution, frequency, and variable requirements to support the analysis and diagnostic development steps described in the project work plan. The use of additional model datasets outside of the CMIP6 framework is encouraged, to accentuate the proposed evaluation and development activities. These can include existing public model datasets or model experiments described in the proposal and carried out as part of the project activities.

The diagnostics software package designed by the MDTF provides context for new PODs developed under this solicitation. Proposals should plan to contribute new PODs to the software package; to apply the software package to models; or to expand the use of the software through relevant collaborations with modeling centers, agencies, research groups, or laboratories (for example, NCAR, PCMDI, E3SM, etc.). The software package is generally coded in Python and available for use and development through GitHub. Proposers should demonstrate a facility with these or similar software and development environments to be able to develop and test PODs within the software framework.

Individual projects that address a set of processes relevant to one or more of the above research areas (type 1) may be funded at a level of up to $180K/year for up to three years. Proposed work plans should account for time spent on participation in a Task Force[10] that will be constituted of the investigators funded as a result of this solicitation. In addition to project primary investigators, postdoctoral fellows and graduate students are also welcome to participate in Task Force activities. Task Forces enable collaboration between funded investigators via monthly teleconferences and through constructive collaborative activities. In the past, Task Forces have produced fact sheets, knowledge statements, collaborative analysis products, and group journal articles; and have organized meeting sessions, special collections, or other activities. Previous Model Diagnostic Task Forces have coordinated the development

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[10]

https://cpo.noaa.gov/Meet-the-Divisions/Earth-System-Science-and-Modeling/MAPP/MAPP-Task-Forces

of the software framework and contribution of process-oriented diagnostics to the framework. Participants in previous MDTFs have coordinated with the Team leadership to develop diagnostics, have presented their work on teleconferences and community meetings, and have contributed to group papers. A team proposal (type 2) is also solicited.

The type 2 team proposal should address the research areas described above and advance key objectives of this solicitation, including the model diagnostics software package led by the MDTF. The team proposal should also describe plans for how to integrate results and activities of the individual projects in a Task Force collectively and synergistically, addressing the core scientific objectives of this solicitation. These will include a vision for collaborative activities to unify participating researchers, infrastructure for data and code sharing, technical support for integration of PODs developed by community members, a methodology to engage researchers in model evaluation and development activities, and plans for publications, documentation, or other outputs that can synthesize and disseminate the work of the Task Force and lead to increased community awareness and utility of the software package. Team proposals should also include support for the integration of PODs from research teams funded outside of this solicitation, depending on the relevance of those PODs. Team proposals should include contributions from multiple institutions and may request up to $400k/year for non-NOAA collaborators and up to an additional $350k/year for activities at or affiliated with NOAA laboratories, for a total annual team proposal resource ceiling of $750k/year.

Competition contact information: Daniel Barrie (daniel.barrie@noaa.gov)

General Guidelines for FY 2021 MAPP proposal submission:

- Principal investigators submitting a proposal in response to this MAPP Announcement are required to follow the Letters of Intent (LOI) and Proposal preparation and submission guidelines described in the Climate Program Office FY 2021 Notice of Federal Funding Opportunity announcement.
- Investigators are strongly encouraged to submit an LOI prior to developing and submitting a full proposal using the FY21 MAPP Letter of Intent submission form[11]; investigators unable to submit via the form should email their LOI to oar.cpo.mapp@noaa.gov. Investigators will be notified by the MAPP Program Competition Manager as to whether a full proposal is encouraged based on the LOI within four weeks of the LOI due date.
- Proposals must clearly identify in their summary which MAPP competition is being targeted (only one competition may be targeted by a given proposal).
- Administrative questions regarding the Notice of Federal Funding Opportunity (e.g. proposal formatting or submission guidelines) should be directed to Diane Brown (diane.brown@noaa.gov).

A webinar will be offered to potential applicants for background on the MAPP program and this solicitation soon after publication of this announcement. For Information on webinar timing and registration

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[11] FY21 Letter of Intent Submission Form

procedures please check the MAPP website[12]; prior to when the webinar is held, potential applicants can also sign-up to receive an email notification[13].

Diversity and Inclusion

MAPP recognizes that it has a particular and unique opportunity and responsibility to support NOAA's and the community's commitment to diversity and inclusion by taking an intentional step that encourages program applicants to consider diversity and inclusion as part of their scientific projects. MAPP supports the goal of increasing the inclusion of underrepresented groups in NOAA-relevant modeling science. This action has the potential to make an impact on not only the diversity and inclusion in science at NOAA, but also beyond the agency. In your proposal, we encourage you to think about how your project can broaden the participation of underrepresented groups (e.g., gender, race, ethnicity, disability, geographic, etc.). Examples could include, but are not limited to, full participation of women, persons with disabilities, and other underrepresented minorities in science, technology, engineering, and mathematics (STEM). Opportunities that may engage students or early career scientists from underrepresented groups at different or earlier ages (e.g., even secondary) in the context of your proposed research are encouraged.

Data Archiving and Computational Resources

Computational Resources
Computational resources on NOAA's high-performance computing platforms may be requested for research sponsored as a result of this solicitation. Proposals should indicate the availability of alternative computing resources should NOAA resources not be available for the project. Proposers who choose to request computational allocations on NOAA's platforms must include in their proposal a request describing the computational resources and data storage required, as well as a description of how they will port their methodology to the NOAA platforms. Proposers must submit an HPC Request Form[14] with their proposal in order to apply for computational resources.

Questions regarding the use of NOAA's high-performance computing platforms should be directed to Dan Barrie (daniel.barrie@noaa.gov).

Data Management Guidance
The MAPP Program requires that all products and deliverables produced via solicitation will reside in the open access / open source domain, freely available to the public.
Public access to grant/contract-produced data will be enabled in one of the following ways (select one):

- Funding recipients are planning to submit data to NOAA National Centers for Environmental Information (NCEI), which will provide public access and archiving[15]. Point of Contact for NCEI is Nancy Ritchey (Nancy.Ritchey@noaa.gov)

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[12] https://cpo.noaa.gov/Meet-the-Divisions/Earth-System-Science-and-Modeling/MAPP
[13] https://docs.google.com/forms/d/e/1FAIpQLSdIHdaDe3TjRGivO9OqdgPSKnEIN6dfHiwBZz9Efm2YMOd33A/viewform
[14] https://cpo.noaa.gov/Portals/0/MAPP_FY21_HPC_Request_Form.docx
[15] NCEI supports the creation of adequate metadata and data ingest into long term repository holdings using tools such as Send2NCEI (www.nodc.noaa.gov/s2n), for small volume, one-time only data collections) and Advanced Tracking and Resource tool for Archive Collections or ATRAC (https://www.ncdc.noaa.gov/atrac/index.html), for recurring and/or large volume data collections).

- Data are to be submitted to an International Council for Science (ICSU) World Data System facility: https://www.icsu-wds.org/community/membership/regular-members)

- An existing publicly accessible online data server at the funded institution is to be used to host these data (describe in proposal).

- An existing publicly accessible online "cloud" service is to be used to host the data (describe in the proposal).

The Competition Manager (above) is the responsible NOAA Official for questions regarding this guidance and for verifying accessibility of data produced by funding recipients.